this view is the established fact that the gas conducts itself as if made up of individual particles, while any allotropic form of nitrogen, which is heavier than this, must, according to all that we know of such matters, consist of more complex molecules than nitrogen itself.

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*THE FUNDAMENTAL DIFFERENCE BETWEEN PLANTS AND ANIMALS**

To the advanced student, as to the investigator, the question of a definite and accurate distinction by which all true plants can be distinguished from all true animals, is a question of minor interest. To the beginning student the question, on the contrary, is a pressing one for which the answer is urgently claimed. Thus I am led to believe that the definition given below, though it cannot add anything essential to the conceptions of investigators, will nevertheless prove valuable to teachers of biology.

The usual method of drawing a contrast between the animal and vegetable kingdoms, for the purpose of establishing some sort of definition of the two in students' minds, is to leave out of consideration the lower forms, and to take into consideration only the higher forms, on the one side plants with chlorophyll, on the other the multicellular animals or so-called Metazoa. It is then easy to establish a difference in the physiological nutritive processes, emphasizing the synthetic processes, particularly the power of bringing free nitrogen into combinations on the part of plants and the absence of the synthetic process among animals. It is much to be regretted that this method of defining animals and plants has been and still is very widely used, for it leads to inevitable perplexity, because the next thing almost which the student must learn is that the distinction does not hold true. On the one hand, he learns that among plants there are many forms without chlorophyll and that these cannot bring nitrogen into combination and must secure proteid food. On the other hand, he learns that among animals numerous synthetic processes occur, and if he takes up the study of medical physiology he learns many instances of synthetic chemical work on the part of the mammalian body. Dr. F. Pfaff has kindly indicated to me two striking instances of synthesis in the mammalian body, first, the formation of glycuronic acid after the administration of camphor or turpentine, and second, the formation of hippuric acid after the administration of benzoine.

Another distinction often drawn between animals and plants is that of the presence or absence respectively of internal digestive organs. But this again soon leaves the student in the lurch, for the first amœbea he examines knocks that distinction out of the ring.

We may, however, I think, rightly define the two primary divisions of the living world thus:

Animals are organisms which take part of their food in the form of concrete particles, which are lodged in the cell protoplasm by the activity of the protoplasm itself.

Plants are organisms which obtain all their food in either the liquid or gaseous form by osmosis (diffusion).

There are certain facts which appear to invalidate these definitions. The most important of such facts, so far as known to me, is afforded by the Myxomycetes, which, as well known, while in the plasmodium stage of their life-cycle, take solid particles of food very much after Amœba-fashion. Through the kindness of Professors W. G. Farlow and G. L. Goodale, I have learned that there are no other plants which at the present time are known to take solid food

* Read before the American Society of Morphologists at Baltimore, December, 1894.

at any stage. I understand also that botanists are by no means agreed to accept the Myxomycetes as veritable plants. One cannot but ask, Have we not here organisms which connect the two kingdoms? Certainly, in using the above definitions in teaching, it will always be easy to specify the one exception offered by the Myxomycetes and still leave a clear and available conception in the student's mind.

Other facts, which stand in the way of strictly upholding the two definitions, are encountered among animal parasites. For example, a tape-worm in the intestine does not apparently take up any solid food, but is nourished by absorption through the surface of its body of food material in solution. But in these cases we have evidently secondary modifications due to the parasitic life, and in the near relatives of the tape-worms, the trematods and planarians, solid food is taken up. It is to be remarked, too, that it is possible, though perhaps not probable, that even tape-worms will be found on more careful study to take up solid food.

The extent to which it has now been demonstrated that animals take up food in the form of discrete solid particles is not realized generally. The process has been observed with varying degrees of accuracy in the entodermal cells of the digestive tract of hydroids, ctenophores, planarians, trematods, annelids, crustacea, insects, amphibia and mammals, and probably in other forms, which have not come to my notice in this regard. There is here offered a rare opportunity for a valuable research, by making a comparative study of the absorption of solid food. That the protozoa take up particles by means of their pseudopodia is certainly one of the most familiar and most be-taught facts of elementary biology.

I believe that we can also safely teach that the absorption of solid particles of food is to be considered one of the most essential factors in determining the evolution of the animal kingdom. The plant receives its food passively by absorption, and the evolution of the plant world has been dominated by the tendency to increase the external surfaces—to make leaves and roots. The animal, on the contrary, has to obtain at least the solid part of its food by its own active exertions, and to the effects—through natural selection—of the active struggle to secure food we may, I think, safely attribute a large part of the evolution of locomotor nervous and sensory systems of animals. That it has been the only factor cannot be asserted of course for a moment, but it is presumably not going too far in speculative conclusions to look upon it as the most important single factor. An equally important rôle must be attributed to the taking of solid food in connection with the evolution of digestive organs, which are cavities which hold food material until it is absorbed by the cellular walls of the cavities. Indeed, we may expect to find that the entodermal cavity had originally no digestive function whatsoever, but was merely a receptacle to retain the food while the surrounding entodermal cells swallowed it at leisure.

With these speculations I will close, adding only that the speculations have in themselves little value, their only value being to suggest lines of research, which appear promising. The sober naturalist avoids the infernal dipsomania for sheer speculation, and in this article I have already yielded sufficiently to the temptation.

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THE BEST ORDER OF TOPICS IN A TWO-YEARS' COURSE OF ANATOMY IN A MEDICAL SCHOOL.*

Teachers of anatomy differ so widely in their views as to the most useful arrangement of the various branches of the subject

*A paper read at the annual meeting of the *Association of American Anatomists*, in New York, 28th December, 1894.